NXP's TJA108x FlexRay transceiver family

Your partner for FlexRay

FLEXRAY HISTORY AND NXP'S ROLE AND CONTRIBUTION

A brief review

The history of FlexRay started in the late 1990s, when several car makers recognized that their future In-Vehicle Networking (IVN) requirements could not be solved with existing networks such as CAN. These car makers therefore decided to found a consortium – FlexRay Consortium – to develop and drive the adoption of an industry standard – FlexRay – for high-speed, time-triggered communication networks for automotive applications. NXP Semiconductors (formerly Philips Semiconductors) was invited to become one of the founding (core) members of this FlexRay Consortium and has been leading the Physical Layer Working Group ever since. Because of its core membership, NXP Semiconductors (NXP) also held a chair in the Steering Committee and Executive Board until the FlexRay Consortium ceased operations on December 31, 2009. NXP developed the first hardware solution to enable other Consortium members to perform system studies on FlexRay applications. This product is known as the TJA1080.

NXP INNOVATION- AND VOLUME-LEADER IN AUTOMOTIVE NETWORKING

NXP has shipped more than 15,000,000 FlexRay transceivers!!

An important milestone was achieved in late 2006, when the first car model using FlexRay networking was taken into mass production: the BMW X5, which uses NXP's TJA1080 in an active damping control system. In 2008, BMW launched the 7-series, with a FlexRay network consisting of some 15 nodes supporting several applications. Audi also selected NXP FlexRay transceivers for their new luxury sedan, the Audi A8, launched in 2010. Meanwhile FlexRay is also used in (high volume) mid-end car models. As a result, NXP has already shipped more than 15,000,000 FlexRay transceivers.

FLEXRAY IS GETTING GLOBAL

FlexRay and JASPAR[1] requirements merged into one (global) standard

The Japanese automotive industry decided that it would be beneficial to have a domestic consortium to focus on FlexRay applications. This led to the formation of the JASPAR consortium, in 2004, under the leadership of Toyota, Nissan and Honda. NXP joined JASPAR in 2007, not only to get a clear understanding of the differences between FlexRay and JASPAR applications, but also to actively contribute to JASPAR Working Groups. Meanwhile, the FlexRay Consortium and JASPAR aligned on a common physical layer specification, the Electrical Physical Layer Specification (EPL) V3.0.1, which has been released in 2011.

Recognizing the importance of Japanese car industry, NXP has installed an extensive automotive team in Japan to adequately support its automotive customers.

[1] JASPAR: Japan Automotive Software Platform Architecture

NXP'S TJA1080

FlexRay enabler and first FlexRay transceiver in mass production

As the world's first silicon for the FlexRay electrical physical layer, the TJA1080 proves FlexRay's power and versatility. This device has played a key role in driving new, advanced communication systems into cars by offering an extensive feature set, excellent EMC performance, and high ESD protection.

Ever since the TJA1080 was taken into mass production, NXP has benefitted from market feedback and its experience in mass producing this part. This very valuable information helped to define new products for future applications and to tailor the product specifications and features to the wishes of NXP's customers. Of course NXP's transceiver products also comply with automotive quality and reliability requirements. To achieve this NXP used its 'Design-for-Excellence' approach during the development phase.

TJA1080A

Building on experience

Market feedback taught us that some fine-tuning of the TJA1080 was needed, which could not be implemented in a product running in mass production. This was the reason for introducing a successor part: the TJA1080A. At the same time, the FlexRay Consortium also finalized the first test specification for conformance testing. The TJA1080A was tested and passed in November 2007, becoming the first FlexRay-conforming transceiver in the market.

Like the TJA1080, the TJA1080A can be configured as a node transceiver or as an active star coupler with one branch. This makes the TJA1080A the most versatile FlexRay transceiver available in the market. The TJA1080A has been in production since 2009. Production of the TJA1080 stopped in 2010.

Both the TJA1080 and the TJA1080A laid the foundation of the current maturity of the FlexRay physical layer.

In order to further drive FlexRay adoption, NXP completed their FlexRay transceiver portfolio with cost-optimized node/active star only transceivers, compliant with the latest industry standards.

TJA1081

Basic 'clamp 30' node transceiver

Similar to the TJA1080A, the TJA1081 provides error diagnosis and status register readout functions. This device is a cost-optimized 'clamp 30' node transceiver (without star functionality), in an SSOP16 package. The TJA1081 can be used as a drop-in replacement for the TJA1080A. The TJA1081 consumes very little current in sleep and standby mode and supports minimum bit times down to 60 ns, thereby outperforming the EPL V3.0.1 specification. The TJA1081 also supports ECU low power management via the INH pin and the 'EPL V3.0.1' wakeup mechanism via a dedicated FlexRay data frame.
The TJA1081 is in production since 2009.

TJA1081B

EPL V3.0.1 & JASPAR compliant successor to the TJA1081 with improved EMC and ESD

With the TJA1083 and TJA1085, NXP offers a state-of-the-art solution for "clamp 15" and "Active Star" based ECUs. Both transceivers not only comply with EPL V3.0.1 and JASPAR, but also meet the very latest industry standards on EMC and ESD. The TJA1081 is NXP's EPL V2.1 Rev. A compliant "clamp 30" node transceiver (with a direct battery connection). Given the TJA1081 was released in 2009 and the industry meanwhile changed the EMC and EMC requirements, NXP decided to introduce the TJA1081B. The TJA1081B is the footprint compatible successor of the TJA1081 which not only meets the latest EMC and ESD industry standards, but is also EPL V3.0.1 & JASPAR compliant. With the TJA1081B, NXP's FlexRay transceiver portfolio is "state-of-the-art" and future proof.
The TJA1081B is released in 2012.

TJA1082

Basic 'clamp 15' node transceiver

The TJA1082 is optimized for ECUs that are switched off by the ignition key ('clamp 15' operation) and is easy to apply and to design in. Due to the tailored functionality, compared to the TJA1080A, the package size and footprint are smaller and the pin count is lower. The TSSOP14 package, which has a footprint of only 4 mm by 6.4 mm, makes the TJA1082 nearly as small as a standard high-speed CAN transceiver in an SO8 package (such as the NXP TJA1051 and TJA1042). The TJA1082 is compliant with EPL V2.1 Rev. B.

Like the TJA1080A and the TJA1081, the TJA1082 supports minimum bit times down to 60 ns and a wakeup mechanism via a dedicated FlexRay data frame. It also has a low-power receiver, which is active in stand-by mode. Besides this, several protection and diagnostics functions are available: undervoltage detection, bus error detection and temperature protection. This diagnostic information can be transferred to a microcontroller using a standard SPI interface. The TJA1082 operates from a normal 5 V supply voltage and can interface to a microcontroller with a wide range of supply voltages.
The TJA1082 is released in 2009.

TJA1083

The 'global' transceiver EPL V3.0.1 and JASPAR compliant

The JASPAR activities resulted in some new transceiver requirements, which have been incorporated in EPL V3.0.1 and are specified in the functional class called 'Bus driver - Increased voltage amplitude transmitter'. Anticipating the release of EPL V3.0.1, NXP started the development of a 'global' FlexRay transceiver – TJA1083 - which is not only EPL V3.0.1 compliant but also meets the JASPAR specific requirements. Due to its 'global' concept, the TJA1083 will achieve higher volumes; higher volumes will boost quality and economies of scale. The TJA1083 is pin- and footprint-compatible to the TJA1082, making it a logical and easy upgrade to EPL V3.0.1.
The TJA1083 is released in 2012.

TJA1085

EPL V3.0.1 and JASPAR compliant 4-branch active star coupler

The FlexRay standard allows passive bus topologies and topologies with an active star coupler, or a mix of these. From the beginning, FlexRay networks have been built around active star couplers consisting of several branches. The versatile TJA1080A was used for these first implementations of star architectures. However, for a cost-optimized, mass-production solution, a dedicated star coupler product is preferred. For this reason, the TJA1085 star coupler has been added to our FlexRay portfolio.

This 4-branch active star coupler – basically replacing four instances of a single TJA1080A – will be compliant with FlexRay EPL V3.0.1, thus ensuring optimized timing behavior and a 100% fit to protocol mechanisms. With its enhanced bus error detection and diagnosis, the TJA1085 enables faster and more reliable error confinement. Branch-wise 'partial networking' completes the TJA1085's unique feature set.
The TJA1085 is released in 2012.

TJA1086

EPL3.0.1 and JASPAR compliant 2-branch active star coupler

Like the TJA1085, the TJA1086 is an active star coupler however with 2 branches instead of 4. The TJA1085 and TJA1086 are package and footprint compatible, allowing scalable active star implementation depending on the features of the car.
The TJA1086 is released in 2013.

With the TJA1081B, TJA1083, TJA1085 and TJA1086 NXP offers a complete and future proof FlexRay transceiver portfolio and therefore these parts are recommended for new design-ins.

NXP: YOUR PARTNER IN THE FLEXRAY BUSINESS

NXP is the market leader in IVN transceivers and a FlexRay market shaper. Moreover, thanks to our unparalleled track record in IVN volume supply, we can provide excellent supply security. To enable easy design-in of our products, we offer extensive IVN system knowledge and responsive customer support. For released FlexRay products, we provide transceiver simulation models and support network topology simulations for car OEMs.

NXP sees the FlexRay market developing quickly. Increasingly, OEMs around the world are adopting FlexRay technology by implementing FlexRay networks in their vehicles. NXP's next-generation FlexRay physical layer products target enhanced features, like partial networking, enhanced EMC, reduced current consumption ('green driving'), and a higher level of integration. Combined with a smaller footprint, this next-generation FlexRay transceiver not only offers optimized system costs but will also significantly save board space.

All NXP's FlexRay transceivers are FlexRay compliant. This ensures proper interoperability with FlexRay compliant protocol controllers and FlexRay compliant physical layer devices without exception and under all circumstances.

POTENTIAL FLEXRAY APPLICATIONS

- Vehicle Dynamics (braking, suspension, steering)
- Driver Assistance
- Intelligent Parking Assist
- Adaptive Cruise Control
- Fuel Control Systems
- Traction Control Unit
- Intelligent Power Assisted Steering
- Lane Departure Warning System
- Electronic Power Assisted Steering
- Electronic Stability Control

TJA108x selection guide

	TJA1080A	TJA1081	TJA1082	TJA1081B	TJA1083	TJA1085	TJA1086
Main characteristics							
FlexRay Node functionality	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Active Star functionality	Yes	No	No	No	No	Up to 4 branches	Up to 2 branches
EPL compliance	V2.1 Rev. A	V2.1 Rev. A	V2.1 Rev. B	V3.0.1	V3.0.1	V3.0.1	V3.0.1
Minimum bit time	60 ns	60 ns	60 ns	60 ns	60 ns	60 ns	60 ns
Minimum transmitter output voltage of 900 mV (JASPAR)	No	No	No	Yes	Yes	Yes	Yes
Auto I/O-level adaptation to host/controller interface (V_{IO})	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mode control	STBN and EN pins	STBN and EN pins	STBN pin	STBN and EN pins	STBN pin	SPI	SPI
Bus guardian interface	Yes	Yes	Yes including feedback	Yes including feedback	Yes including feedback	Yes including feedback	Yes including feedback
Power management							
Standby and sleep mode	Yes	Yes	Standby only	Yes	Standby only	Yes	Yes
Low power management with INH switch(es)	2 INH switches	1 INH switch	No	1 INH switch	No	1 INH switch	1 INH switch
Sleep current	55 µA	55 µA	30 µA	55 µA	30 µA	55 µA	55 µA
Wakeup via symbol or a (EPL V3.0.1) dedicated FlexRay frame	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wakeup source recognition (local or remote)	Yes	Yes	N/A	Yes	N/A	Yes	Yes
Diagnosis							
Over-temperature detection	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Short-circuit on bus lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clamping of pins TXEN and BGE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Under-voltage detection (on specified pins)	V_{BAT}, V_{CC}, V_{IO}	V_{BAT}, V_{CC}, V_{IO}	V_{CC}, V_{IO}	V_{BAT}, V_{CC}, V_{IO}	V_{CC}, V_{IO}	V_{BAT}, V_{CC}, V_{IO}	V_{BAT}, V_{CC}, V_{IO}
Error signalling	ERRN	ERRN	ERRN	ERRN	ERRN	INTN	INTN
Error diagnosis and status vector readout	EN / ERRN	EN / ERRN	SPI	EN / ERRN	SPI	SPI	SPI
Provided information	Error and status	Error and status	Error and status, or simple error indication	Error and status	Error and status, or simple error indication	Error and status; general and per branch	Error and status; general and per branch
Protections							
ESD protection for off-board pins	±8 kV HBM	±8 kV HBM	±8 kV HBM and according to IEC61000-4-2	±6 kV HBM and ±6 kV according to IEC61000-4-2	±8 kV HBM and ±6 kV according to IEC61000-4-2	±8 kV HBM and ±6 kV according to IEC61000-4-2	±8 kV HBM and ±6 kV according to IEC61000-4-2
Bus pins short-circuit proof to battery voltages of 14 and 42 V and ground (48 V support)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fail-safe behavior incase of an under-voltage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Passive behavior of bus lines when unpowered	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other							
Package	SSOP20	SSOP16 (fits on TJA1080A footprint)	TSSOP14	SSOP16 (fits on TJA1081 and TJA1080A footprint)	TSSOP14 (fits on TJA1082 footprint)	HVQFN44 package with wettable flanks	HVQFN44 package with wettable flanks
Availability	In production	In production	In production	In production (Recommended for new design-ins)	In production (Recommended for new design-ins)	In production (Recommended for new design-ins)	In production

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Date of release: April 2013
Document order number: 9397 750 17415
Printed in the Netherlands